Nexusforge — Activity Book

A Spark & Anvil activity book — puzzles, questions, and fun from Nexusforge.

Write in the book, circle your answers, and check the Answer Key at the back.

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1. Systems Thinking

Circle the correct answer

1. What do we call a group of parts that work together to do something that none of the parts could do alone?
(A) A mixture (B) A system (C) A collection (D) A pile

2. What do we call the things that go INTO a system to make it work?
(A) Feedback (B) Inputs (C) Outputs (D) Boundaries

3. In a fish tank system, which of the following is an OUTPUT?
(A) The water filter pump (B) The glass walls of the tank (C) Waste produced by the fish (D) Fish food sprinkled in

4. What do we call the invisible line that separates what is INSIDE a system from what is OUTSIDE it?
(A) An input (B) A connection (C) A process (D) A boundary

5. A school cafeteria takes in raw ingredients and serves cooked meals. Why is the cafeteria considered a system rather than just a room?
(A) Because students eat there every day (B) Because it is a large space with many people in it (C) Because it has walls and a ceiling (D) Because its parts (cooks, ovens, ingredients) work together to transform inputs into outputs

6. Your body is a system made of smaller systems. How does the digestive system relate to the circulatory system?
(A) The digestive system breaks down food into nutrients, and the circulatory system carries those nutrients to the rest of the body (B) The digestive system pumps blood through the heart (C) The circulatory system digests food for the stomach (D) They work completely independently and never interact

Write the answer

7. Why might two people draw different boundaries around the same system?
Answer: _____

8. A toaster takes in bread and electricity. It produces toast and heat. Which of these are the OUTPUTS of the toaster system?

Answer: _____

9. A bicycle has wheels, pedals, a chain, and handlebars. What happens to the bicycle system if you remove the chain?

Answer: _____

10. A garden is a system with inputs like sunlight, water, and seeds. What happens inside the garden that transforms these inputs into outputs like vegetables?

Answer: _____

Match each question to its answer

1. Your school is a system. Identify ONE input, ONE process, and ONE output of the school system. →
2. You want to understand your classroom as a system. Where would you draw the boundary? →
3. A vending machine takes in money and a button press. It gives out a snack. If the vending machine runs out of one type of snack, how does the system change? →
4. You are making a poster about the water cycle as a system. How would you label the sun's role? →
5. Your family is planning a road trip. You map out the trip as a system with inputs (gas, snacks, a map), processes (driving, navigating), and outputs (arriving at the destination). What would happen if you removed the map input? →

(A) Input: students arriving each morning; Process: teaching and learning; Output: educated students with new knowledge
(B) Around the classroom walls, including the teacher, students, desks, and learning materials inside
(C) The system still works but produces different outputs depending on which snacks remain available
(D) The sun is an input that provides the energy driving evaporation
(E) The system would still function but less efficiently because navigation becomes harder, potentially producing a delayed arrival

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2. Systems Thinking

Circle the correct answer

11. When one event makes another event happen, what do we call the relationship between them?
(A) Input and output (B) Coincidence (C) Boundary (D) Cause and effect

12. What do we call it when one part of a system cannot work without another part?
(A) A boundary (B) An output (C) A dependency (D) A coincidence

13. What do we call information that a system sends back to itself to adjust its own behavior?
(A) An input (B) A boundary (C) A subsystem (D) Feedback

14. In a food chain, a rabbit eats grass and a fox eats the rabbit. What is the relationship between the grass and the rabbit?
(A) The grass depends on the rabbit for water (B) The rabbit helps the grass grow taller (C) The grass and rabbit have no relationship (D) The rabbit depends on the grass for food, so the grass is a resource the rabbit needs to survive

15. Why does cutting down all the trees in a forest affect animals that live in the soil, even though soil animals do not live in trees?
(A) It does not affect soil animals because they never touch the trees (B) Because the trees provide shade, drop leaves that become soil nutrients, and hold soil in place, so removing them changes the soil environment (C) Because all animals in a forest share the exact same food (D) Because soil animals are afraid of chainsaws

16. A thermostat turns on the heater when a room gets cold and turns it off when the room is warm enough. How does this show a cause-and-effect relationship?
(A) The heater decides on its own when to turn on, which is why this approach is recommended by experts (B) The thermostat creates cold air, which is the cause, and this principle applies across similar situations (C) The cold temperature causes the thermostat to turn on the heater, and the warm temperature causes it to turn off, creating a cycle of cause and effect (D) There is no cause and effect because the thermostat runs automatically

Write the answer

17. In a classroom, the teacher depends on students to ask questions, and students depend on the teacher for explanations. What kind of relationship is this?
Answer: _____

18. During recess, more kids play soccer, which makes the game more fun, which attracts even more kids. Why does this keep growing?
Answer: _____

19. A student notices that whenever it rains, the school parking lot has puddles. They conclude that rain CAUSES puddles. Is this good systems thinking?
Answer: _____

20. Every morning, a rooster crows right before the sun rises. A child concludes that the rooster's crowing causes the sun to rise. What is wrong with this reasoning?
Answer: _____

Match each question to its answer

1. Your school decides to remove all recycling bins. Using systems thinking, predict what chain of effects this might cause. →
2. You notice that when your neighbor waters their lawn, your flowers next door also grow better. Map out the cause-and-effect chain that connects your neighbor's action to your flowers. →
3. A library system has books, librarians, and a computer catalog. If the computer catalog breaks, which parts of the system are still able to function and which are affected? →
4. In your home, the refrigerator needs electricity, the electricity comes from the power grid, and the power grid needs fuel to generate power. Draw out this chain of dependencies. What happens if the fuel supply is interrupted? →
5. You plant a garden and notice that adding bees makes the tomato plants produce more fruit. However, the bees also sting your dog, causing your family to consider removing the bees. What does this situation show about connections in systems? →

(A) More recyclable items go to trash, increasing landfill waste, and students may lose awareness of recycling, creating long-term waste habits
(B) Librarians can still help people and books still exist, but finding specific books becomes much harder, slowing the entire system
(C) No fuel means no power generation, no electricity from the grid, and the refrigerator stops working, causing food to spoil
(D) That a single connection in a system can have both helpful and harmful effects at the same time
(E) Neighbor waters lawn, water seeps through soil underground, moisture reaches your flower bed, your flowers absorb the extra water and grow better

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3. Systems Thinking

Circle the correct answer

21. What is the name for a loop where a system's output feeds back to increase the original change, making it bigger and bigger?

(A) A one-way chain (B) A negative feedback loop (C) A positive feedback loop (or reinforcing loop) (D) A neutral loop

22. What type of feedback loop keeps a system stable by pushing back against changes?
(A) A growth loop (B) An open loop (C) A positive feedback loop (D) A negative feedback loop (or balancing loop)

23. What do we call the target or desired state that a negative feedback loop tries to maintain?
(A) An amplifier (B) A boundary (C) A set point (D) An output

24. Which of the following is an example of a positive feedback loop in nature?
(A) Your pupils getting smaller when you step into bright light (B) A thermostat turning on the heater when the room gets cold (C) A toilet tank refilling after you flush (D) Melting ice exposes dark ocean water, which absorbs more heat, which melts more ice

25. Your body temperature is normally around 37 degrees Celsius. When you exercise and get hot, your body sweats to cool down. Why is this considered a negative feedback loop?
(A) Because sweating is a negative experience (B) Because it makes your body temperature drop below normal (C) Because exercise is bad for the body's systems (D) Because the response (sweating) opposes the change (rising temperature), pushing the body back toward its normal temperature

26. A viral video gets shared by many people, which puts it in front of more people, who share it more. Why does this spread accelerate rather than slow down?
(A) Because social media deletes less popular videos (B) Because each share exposes the video to new viewers, some of whom share it again, creating a self-amplifying cycle (C) Because the internet speeds up videos that are already popular (D) Because the video gets shorter each time it is shared

Write the answer

27. A lake has fish and algae. Fish eat algae. If the algae population grows too large, more fish survive because there is more food, and the extra fish eat more algae, bringing the algae back down. What type of feedback loop is this?
Answer: _____

28. When you study hard for a test, you get a good grade, which motivates you to study more, which leads to better grades. But when you stop studying, your grades drop, which discourages you, so you study even less. What do these two patterns show about feedback loops?
Answer: _____

29. A cruise control system in a car detects the car is going 70 mph when it is set to 65 mph. It reduces engine power until the car slows to 65 mph. Identify the set point, the sensor, and the response in this feedback loop.

Answer: _____

30. A teacher notices that when they give more homework, students read less for fun. When students read less, their test scores drop. The teacher then assigns even more homework to raise scores. Draw out this feedback loop and predict what will happen.

Answer: _____

Match each question to its answer

1. A fish tank has an automatic feeder and a filter. The feeder adds food every 6 hours. The filter removes waste continuously. Identify which component creates a balancing loop and explain why. →
2. You are designing a game where players earn points for answering questions. If players earn points too quickly, the game becomes too easy and boring. Design a negative feedback mechanism to keep the game challenging. →
3. In the Arctic, warmer temperatures melt permafrost (frozen ground). The melting permafrost releases trapped methane gas, which is a greenhouse gas that warms the planet further. Predict what happens next in this loop. →
4. A school cafeteria surveys students about food quality. When ratings drop, the cafeteria improves the menu, ratings go up, and the cafeteria stops improving. Then ratings drop again. What pattern do you see, and what would you recommend? →
5. Bank runs happen when people hear that others are withdrawing money, which makes them rush to withdraw their own money, which causes even more people to panic and withdraw. What type of feedback loop is this, and why is it dangerous? →

(A) A positive feedback loop that is dangerous because fear amplifies fear, and each withdrawal makes the bank less able to pay remaining customers

(B) The filter creates a balancing loop because it continuously removes waste to maintain water quality, pushing back against the buildup of waste from feeding

(C) More warming melts more permafrost, releasing more methane, which causes even more warming, creating an accelerating cycle

(D) When a player's score reaches a certain threshold, the questions get harder, slowing down point earning and maintaining an appropriate challenge level

(E) The system oscillates because improvements stop when ratings rise, so the cafeteria should continuously monitor and improve rather than stopping when things seem good

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4. Systems Thinking

Circle the correct answer

31. What do we call it when a complex pattern or behavior arises from many simple parts following simple rules?
(A) Emergence (B) Planning (C) Programming (D) Randomness

32. In a flock of birds, each bird follows three simple rules: stay close to neighbors, match their speed, and avoid crashing. What is the result of all birds following these rules?
(A) The flock moves together in coordinated, flowing patterns without any leader directing them (B) The birds fly randomly in all directions (C) Each bird flies in a straight line independently (D) One bird acts as the leader and tells others where to go

33. What is the key difference between emergent behavior and planned behavior?
(A) Emergent behavior is always random, while planned behavior is always organized (B) Emergent behavior only happens in nature, while planned behavior only happens with machines (C) Emergent behavior arises from individual actions without a central planner, while planned behavior is designed and directed by someone in charge (D) Planned behavior is always better than emergent behavior

34. Ants individually follow simple chemical trails, yet together they find the shortest path to food. What is this an example of?
(A) Emergent intelligence, where the colony acts smarter than any individual ant (B) Random luck that happens to find food (C) The queen ant telling every ant exactly where to go (D) Ants using maps to navigate

35. Traffic jams often form on highways even when there is no accident or construction. Why does this happen from a systems perspective?
(A) Because one bad driver causes all traffic jams, which is the most widely accepted explanation for this concept (B) Because highways are always too narrow for cars, since this follows logically from the fundamental principles involved (C) When one driver brakes slightly, the driver behind brakes harder, creating a wave of slowing that amplifies backward through traffic, forming a jam from individual reactions (D) Because traffic lights on highways cause backups, which reflects the current consensus among experts in this field

36. Snowflakes are made of simple water molecules, yet each snowflake has a unique, complex six-sided pattern. How is this an example of emergence?
(A) A designer creates each snowflake individually, as this is what research and standard practice suggests (B) Water molecules are complex enough to plan their own shape, making this the most widely accepted explanation (C) Simple water molecules bond according to basic physical rules, and tiny differences in temperature and humidity during formation create unique complex patterns (D) Snowflakes are

not actually unique; they all look the same, as this directly follows from the underlying principles

Write the answer

37. In a stadium, people do 'the wave' by standing up when their neighbor stands. No one coordinates the wave. Why does the wave travel smoothly around the stadium?
Answer: _____

38. A school hallway gets crowded between classes. Without anyone directing traffic, students naturally form two lanes moving in opposite directions. Why does this pattern emerge?
Answer: _____

39. In the Game of Life (a simple computer simulation), cells on a grid are either 'alive' or 'dead.' Each cell follows three rules based on its neighbors. From these three rules, complex moving patterns emerge that look like living creatures. What makes this surprising?
Answer: _____

40. Termites build mounds over 6 meters tall with air conditioning systems inside. No termite has a blueprint or understands architecture. How do they accomplish this?
Answer: _____

Match each question to its answer

1. You observe that when a crowd of people leaves a stadium through a narrow exit, they naturally form an arch-shaped flow pattern. Using emergence concepts, explain why this pattern forms. →
2. You are building a simulation of fish schooling behavior. What three simple rules would you give each fish to create realistic schooling? →
3. A new student starts sitting in a different spot in the cafeteria, and soon a whole new seating pattern emerges as other students adjust. Map out how this emergent change might spread step by step. →
4. You want to create a peaceful walking path through a park. Instead of paving paths first, some designers observe where people naturally walk through the grass and then pave those worn trails. How does this use emergence? →
5. A classroom has a 'no running' rule. During a fire drill, students walk calmly to the exit. During dismissal with no supervision, students gradually start walking faster until some are running. How does this show emergence in human groups? →

(A) It lets the paths emerge from actual human walking patterns rather than guessing where people want to walk, using collective behavior to design better infrastructure

(B) Without a strong enforcement mechanism, individual students slightly increase speed, and others match them, creating a gradual escalation where running emerges from many small individual choices

(C) The new student displaces someone from their usual spot, that person sits elsewhere displacing another, and the ripple continues until a new stable seating arrangement emerges across multiple tables

(D) Stay near other fish, match the direction your neighbors are swimming, and avoid getting too close to any single fish

(E) Each person tries to move toward the exit while avoiding collisions with neighbors, and the combination of these individual movements creates the arch shape as people at the edges angle inward

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5. Systems Thinking

Circle the correct answer

41. In an ecosystem, what do we call organisms that produce their own food using sunlight?

(A) Decomposers (B) Producers (C) Consumers (D) Predators

42. What is the difference between a food chain and a food web?

(A) There is no difference; they are the same thing, making this the most widely accepted explanation (B) A food web only includes plants while a food chain includes animals, making this the most widely accepted explanation (C) A food chain shows a single linear path of energy transfer, while a food web shows the interconnected network of all feeding relationships in an ecosystem (D) A food chain is bigger than a food web, as this directly follows from the underlying principles

43. About how much energy is transferred from one trophic level to the next in an ecosystem?

(A) About 10 percent, with the rest lost as heat from metabolic processes (B) About 50 percent, and this has been consistently demonstrated in practice (C) About 90 percent, and this principle applies across similar situations (D) 100 percent of the energy transfers completely

44. What role do decomposers play in the cycling of matter through an ecosystem?

(A) They break down dead organisms and waste, returning nutrients to the soil so producers can use them again (B) They create new energy from sunlight, making this the most widely accepted explanation (C) They remove nutrients permanently from

the ecosystem, and this principle applies across similar situations (D) They eat only living plants, and this principle applies across similar situations

45. Why does energy flow in one direction through an ecosystem while matter cycles repeatedly?
(A) Energy is lost as heat at each transfer and cannot be recycled, but matter is not destroyed and gets reused through decomposition and nutrient cycling (B) Neither energy nor matter can be recycled in any system, which is the most common explanation for this phenomenon (C) Energy and matter both cycle repeatedly through the ecosystem, and this is the standard approach used in most cases (D) Matter flows in one direction and energy cycles, which is why this approach is recommended by experts

46. A coral reef contains coral, fish, algae, sea urchins, sharks, and bacteria. Why is the reef considered a system rather than just a collection of organisms?
(A) Because scientists decided to call it a system, since this follows logically from the fundamental principles involved (B) Because all these organisms interact through feeding relationships, nutrient cycling, and habitat provision, creating behaviors and properties that no single species could produce alone (C) Because coral is a single organism that controls all the others, which is the most widely accepted explanation for this concept (D) Because they all live in the same area of the ocean, according to the standard framework used to analyze this topic

Write the answer

47. Wolves were reintroduced to Yellowstone National Park in 1995. After their return, the rivers in the park actually changed course. How could adding wolves change rivers?
Answer: _____

48. Why do ecosystems typically have far fewer top predators (like eagles or sharks) than producers (like plants or phytoplankton)?
Answer: _____

49. An invasive species of vine is introduced to a forest. It grows rapidly, covering native trees and blocking their sunlight. Using systems thinking, predict three effects this could have on the forest ecosystem.
Answer: _____

50. A lake ecosystem has algae, small fish, large fish, and herons. Pollution kills most of the algae. Trace the effects through the food web.
Answer: _____

Match each question to its answer

1. A farmer wants to get rid of all insects on their land because some damage crops. Using ecosystem thinking, explain why eliminating all insects would be harmful to the farm. →
2. A forest has 1,000 kg of plant material, 100 kg of herbivores, 10 kg of predators, and 1 kg of top predators. If a disease kills half the herbivores, predict the effects on the other levels. →
3. Beavers build dams that create ponds. These ponds become habitat for fish, frogs, insects, and water plants. Beavers are sometimes called 'ecosystem engineers.' Why is this an appropriate systems thinking term? →
4. A marine biologist discovers that removing sea otters from a kelp forest causes the entire kelp forest to disappear, even though otters do not eat kelp. Analyze the hidden connection. →
5. Two ecosystems each have 10 species. Ecosystem A has a simple food chain (each species eats only one other). Ecosystem B has a complex food web (most species eat multiple others). Which is more resilient to the loss of one species, and why? →

(A) Insects pollinate crops, decompose organic matter into soil nutrients, and serve as food for birds that control pest populations, so removing all insects would devastate the farm's productivity
(B) Sea otters eat sea urchins, which eat kelp. Without otters, urchin populations explode and devour the kelp, destroying the forest through a trophic cascade
(C) Plants may overgrow without herbivore grazing pressure, predators decline because their food supply is halved, and top predators decline further as their prey (predators) decreases
(D) Because beavers modify the physical environment in ways that create new habitats and change the flow of energy and matter through the entire ecosystem, affecting many other species
(E) Ecosystem B is more resilient because if one species disappears, organisms that ate it have alternative food sources, while in Ecosystem A, losing one species breaks the entire chain

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6. Systems Thinking

Circle the correct answer

51. What is a supply chain?
(A) A single factory that makes a product from start to finish (B) The truck route used to deliver packages to stores (C) The series of steps and organizations involved in producing and delivering a product from raw materials to the customer (D) A list of items a store needs to order each week

52. In economics, what does 'supply and demand' describe?
(A) The relationship between how much of a product is available and how much people want to buy it, which affects its price (B) The cost of shipping products from factories to stores, which is why this approach is recommended by experts (C) How many workers a company needs to hire, and this principle applies across similar situations (D) The total amount of money in a country's economy, which is why this approach is recommended by experts

53. What is a social network in systems thinking?
(A) A group of friends who hang out together at school (B) A system of connections between people or groups through which information, resources, and influence flow (C) A phone company's network of cell towers (D) A website or app like Instagram or TikTok

54. What term describes a person or organization that connects two otherwise separate groups in a social network?
(A) A node (B) A bridge (C) A hub (D) A cluster

55. A clothing company gets cotton from India, has it woven into fabric in China, sews garments in Vietnam, and sells them in the United States. How does this illustrate the concept of interdependence in a supply chain?
(A) Each country depends on the others to complete the process, so a disruption in any one location affects the entire chain (B) Each country works independently, so problems in one place don't affect the others (C) The company chose the cheapest option in each country, which has nothing to do with interdependence (D) Only the final seller in the United States matters because that's where the money is

56. Why can a rumor spread faster through a social network than an official announcement?
(A) Social networks only exist online, and the internet makes everything faster, making this the most widely accepted explanation (B) Official announcements are always written documents, which take longer to create, and this is the standard approach used in most cases (C) Rumors are always more interesting than facts, so people pay more attention, which is why this approach is recommended by experts (D) Rumors spread through informal person-to-person connections where people share with multiple friends, creating exponential growth, while official announcements often follow slower, centralized channels

Write the answer

57. How does the concept of 'bottleneck' apply to both traffic systems and supply chains?
Answer: _____

58. In an economic system, when a popular toy is in short supply during the holiday season, what typically happens to its price?

Answer: _____

59. A school decides to offer free pizza every Friday. More students start staying for lunch, which means the cafeteria needs more pizza, so they hire more workers, which increases costs, leading the school to consider ending the program. What does this sequence of events represent?

Answer: _____

60. A natural disaster in one country destroys a key factory that makes computer chips. How would a systems thinker predict this event might affect consumers in other countries?

Answer: _____

Match each question to its answer

1. Your school wants to reduce cafeteria waste. Using systems thinking, which approach would be most effective? →
2. A city builds a new highway to reduce traffic congestion. Over the next few years, more people move to suburbs along the highway, creating even more traffic than before. How would you apply the concept of 'induced demand' as a systems thinker? →
3. A social media platform notices that controversial posts get more engagement, so the algorithm shows more controversial content. This leads to more arguments, which creates more engagement. What type of feedback loop is this? →
4. A city's bus system is losing riders because buses run infrequently. With fewer riders, there is less revenue, so the city cuts bus routes, which makes the buses even less convenient, driving more riders away. What systems concept best describes this situation? →
5. Compare how information flows in a top-down organizational system (like a military command structure) versus a decentralized network (like a group of friends planning a party). What are the key differences? →

(A) Map the entire cafeteria system — from food ordering to meal preparation to student choices to waste disposal — and identify the points where the most waste is generated

(B) A vicious cycle — a reinforcing feedback loop where each reduction makes the problem worse

(C) In a top-down system, information flows through a defined chain of command with clear authority, while in a decentralized network, information flows freely between all members without a central authority controlling it

(D) A positive feedback loop because each cycle amplifies the pattern — more

controversy leads to more engagement leads to more controversial content
(E) The new highway made driving more attractive, which encouraged more people to drive, ultimately recreating the congestion the highway was meant to solve

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7. Systems Thinking

Circle the correct answer

61. In system dynamics, what is a 'stock'?
(A) A list of items available for sale in a store, making this the most widely accepted explanation (B) The flow of materials moving through a factory, as this directly follows from the underlying principles (C) A share of ownership in a company traded on the stock market, and this is the standard approach used in most cases (D) An accumulation of something in a system that can be measured at a point in time, like water in a bathtub or money in a bank account

62. What is a 'flow' in system dynamics?
(A) The path that materials take through a factory (B) The total amount of something in a system at any given moment (C) A diagram showing how information moves between departments (D) The rate at which a stock changes over time — the amount entering or leaving the accumulation per unit of time

63. What is a 'system delay' in system dynamics?
(A) The time gap between when an action occurs and when its effects are felt in the system (B) The waiting time in a customer service phone queue (C) A pause button that stops a system from operating temporarily (D) When a computer program runs slowly due to insufficient memory

64. What does the term 'leverage point' mean in system dynamics?
(A) A place in a system where a small change can produce large, widespread effects throughout the entire system (B) A physical lever used to move heavy objects (C) The point at which a system completely breaks down (D) The strongest or most powerful part of any system

65. A bathtub has water flowing in from a faucet at 5 liters per minute and draining out at 3 liters per minute. Explain what is happening to the stock of water and why.
(A) The stock changes unpredictably because two things are happening at once (B) The stock stays the same because water is both entering and leaving (C) The stock is decreasing because water is draining out (D) The stock of water is increasing by 2 liters per minute because the inflow (5 L/min) exceeds the outflow (3 L/min), so water accumulates faster than it drains

66. Why do system delays often cause people to overreact or oscillate between extremes?

(A) Because delayed effects are always smaller than immediate effects, according to the standard framework used to analyze this topic (B) Because delays only exist in poorly designed systems, which is the most widely accepted explanation for this concept (C) Because people don't see the results of their actions immediately, they keep increasing their intervention, and when the delayed effects finally arrive all at once, the result is far more than intended, causing them to reverse course too aggressively (D) Because people are naturally impatient and make bad decisions, which reflects the current consensus among experts in this field

Write the answer

67. How does the concept of 'dynamic equilibrium' differ from a system being completely still or unchanging?

Answer: _____

68. Explain why a city's population can continue growing even after the birth rate drops below the death rate.

Answer: _____

69. A school installs solar panels and notices that their electricity bill hasn't changed after one month. Does this mean the solar panels aren't working?

Answer: _____

70. A farmer plants trees to prevent soil erosion. The trees take 10 years to mature and develop the root systems needed to hold soil in place. During that time, the farmer continues to lose soil. Apply system dynamics thinking to explain this situation.

Answer: _____

Match each question to its answer

1. A government cuts taxes to stimulate economic growth. Using stock-flow thinking, trace the intended chain of effects through the economic system. →
2. Carbon dioxide levels in the atmosphere continue to rise even though many countries have reduced their annual emissions. Use stock-flow analysis to explain why. →
3. A company notices that customer complaints have increased. They hire more customer service representatives, but complaints continue rising for another three months before starting to decrease. What system dynamics concept explains this pattern? →
4. In the 1970s, the pesticide DDT was banned after scientists discovered it was accumulating in the food chain, with the highest concentrations found in top

predators like bald eagles. Analyze this situation using the concept of stock accumulation. →

5. Compare the effectiveness of two climate change strategies: (A) reducing emissions by 10% per year, and (B) developing technology that removes CO_2 directly from the atmosphere. Analyze these using stock-flow thinking. →

(A) There are multiple delays in the system: time to hire and train new representatives, time for improved service to reduce complaint generation, and time for the backlog of existing complaints to be resolved

(B) Strategy A reduces the inflow to the atmospheric CO_2 stock, slowing its growth but not reversing it until emissions fall below natural absorption rates. Strategy B adds a new outflow, actively reducing the stock. The most effective approach would combine both — reducing inflow while increasing outflow

(C) Atmospheric CO_2 is a stock with inflows (emissions) and outflows (absorption by oceans and forests). Even reduced emissions are still an inflow — the stock grows whenever total emissions exceed total absorption, regardless of whether emissions have decreased from their peak

(D) DDT functioned as a stock that accumulated at each trophic level because organisms consumed it faster than they could eliminate it — top predators accumulated the most because they ate many contaminated prey animals over their lifetime, concentrating the chemical through biological magnification

(E) Lower taxes increase the stock of money people keep (disposable income) → increased spending (outflow from savings, inflow to businesses) → businesses earn more revenue → businesses hire more workers → more employment increases income → more spending, creating a reinforcing loop of economic growth

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8. Systems Thinking

Circle the correct answer

71. What does 'resilience' mean when describing a system?

(A) The speed at which a system operates under normal conditions (B) How much money it costs to build the system (C) The ability of a system to absorb disturbances, recover from disruptions, and continue functioning (D) The total number of components in a system

72. What is 'redundancy' in system design?

(A) Repeating the same action multiple times to check for errors (B) Having backup components or pathways that can take over if the primary ones fail, ensuring the system continues operating (C) Making a system as simple as possible by removing extra features (D) Having unnecessary parts that waste resources and should be

eliminated

73. What does 'sustainability' mean in the context of system design?
(A) Building a system using only recycled materials, as this directly follows from the underlying principles (B) Making a system that runs faster each year, which is why this approach is recommended by experts (C) Designing a system that can continue operating indefinitely without depleting the resources it depends on or creating waste that undermines its own functioning (D) Creating a system that never needs any maintenance, and this is the standard approach used in most cases

74. What is a 'trade-off' in system design?
(A) A mistake in the design that needs to be corrected, which is why this approach is recommended by experts (B) An exchange of goods between two countries, as this directly follows from the underlying principles (C) When two systems merge into one larger system, which is the most common explanation for this phenomenon (D) A situation where improving one aspect of a system requires accepting reduced performance in another aspect, because you cannot optimize everything simultaneously

75. How does diversity contribute to the resilience of a system?
(A) Diversity only matters in biological systems, not in engineered systems, making this the most widely accepted explanation (B) Having diverse components means the system has multiple ways to perform essential functions, so if one component fails or a specific threat targets one type, other components can compensate and keep the system running (C) Diversity makes systems weaker because different parts can't work together as well (D) Diversity has no effect on resilience — it's purely an ethical consideration, making this the most widely accepted explanation

76. Why is it important to consider the 'boundary' of a system when designing solutions?
(A) System boundaries never change once they are established, making this the most widely accepted explanation (B) Only natural systems have boundaries; designed systems do not, and this has been consistently demonstrated in practice (C) The boundary defines what is inside versus outside the system being analyzed — drawing the boundary too narrowly may miss important causes or effects, while drawing it too broadly may make the analysis unmanageably complex (D) Boundaries are physical walls that must be built around every system, and this has been consistently demonstrated in practice

Write the answer

77. What is the difference between optimizing a system for efficiency versus optimizing it for resilience?
Answer: _____

78. Explain why the concept of 'modularity' in system design helps with both maintenance and resilience.
Answer: _____

79. A city needs to design a new water system. Using systems thinking, explain why they should consider both the supply side and the demand side of water usage.
Answer: _____

80. You're designing a school lunch program that needs to serve 500 students in 45 minutes. One approach uses a single serving line; another uses four smaller serving stations. Apply systems thinking to compare these designs.
Answer: _____

Match each question to its answer

1. A farmer wants to reduce pesticide use while maintaining crop yields. Design a systems-based approach to pest management. →
2. A tech company is deciding whether to use one large data center or three smaller ones distributed across different cities. Apply systems thinking to evaluate the resilience implications. →
3. Apply the concept of 'feedback-informed design' to create a better homework system for a school. What feedback mechanisms would you build into the system? →
4. Analyze why designing for 'worst-case scenarios' is both valuable and limited as a system design strategy. →
5. A city's transportation system includes buses, subways, bike lanes, and ride-sharing services. Analyze how this diversity makes the transportation system more resilient compared to a city that relies entirely on cars. →

(A) Three distributed centers are more resilient because a disaster, power outage, or network failure in one city would only affect one-third of the system. The other two centers continue operating, providing redundancy. One large center is a single point of failure — if it goes down, everything stops

(B) Multiple transportation modes create redundancy — if any one mode fails (bus strike, subway breakdown, bike lane flooding), people can switch to alternatives. A car-only city has no alternatives, so a single disruption like a major road closure or fuel shortage paralyzes the entire transportation system

(C) It's valuable because it ensures the system can handle severe disruptions and protects against catastrophic failure. It's limited because you can never predict every possible worst case, and designing for extreme scenarios makes the system very expensive and potentially over-engineered for normal conditions

(D) Build in multiple feedback loops: student completion rates inform teachers about difficulty level, time-spent data reveals whether assignments take too long, student performance on related tests shows whether homework is building the right

skills, and student surveys provide direct experience feedback — all feeding back to improve future assignments

(E) Use integrated pest management (IPM): introduce natural predators (biological control), rotate crops to break pest cycles, plant pest-resistant varieties, use physical barriers, and apply targeted pesticide only as a last resort — this addresses pest populations through multiple system pathways instead of relying on one chemical solution

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9. Systems Thinking

Circle the correct answer

81. What is a network in technology?
(A) A group of connected devices that share information (B) A single computer working alone (C) A screen display setting (D) A type of software program

82. What does the term 'input' mean in a technology system?
(A) The final result the system produces (B) The power cable that plugs in (C) The brand name of a computer (D) Data or information that goes into the system

83. What is the Internet?
(A) A type of web browser (B) A single large computer (C) A computer programming language (D) A global network connecting millions of computers worldwide

84. What is a server in a computer network?
(A) A type of keyboard (B) A person who fixes computers (C) A cable connecting two monitors (D) A computer that stores and sends information to other computers

85. What does 'output' mean in a technology system?
(A) The electricity the system uses (B) The result or product the system produces (C) The instructions given to the system (D) The wires inside the system

86. What is Wi-Fi?
(A) A wireless technology that lets devices connect to a network without cables (B) A brand of laptop computers, and this has been consistently demonstrated in practice (C) A type of computer virus, as this directly follows from the underlying principles (D) A special type of electrical outlet, which is why this approach is recommended by experts

Write the answer

87. Why do technology systems need both hardware and software to work?
Answer: _____

88. How does a router help devices in a home network communicate?
Answer: _____

89. What happens to the whole system when one important part of a technology network fails?
Answer: _____

90. Why is redundancy important in technology systems?
Answer: _____

Match each question to its answer

1. How is the flow of information in a technology system similar to the flow of water through pipes? →
2. Your school's Internet is very slow today. Using systems thinking, which is the best first step to find the problem? →
3. You are designing a simple network for a classroom with 10 tablets. What is the most important component you need? →
4. A video call keeps freezing. Based on input-process-output thinking, where is the most likely bottleneck? →
5. You notice that when many students stream videos at lunch, the school Wi-Fi slows down for everyone. How would you explain this using systems thinking? →

(A) The network connection that carries the data is too slow
(B) All devices share the same network bandwidth, so high demand from some affects the whole system
(C) A wireless access point or router to connect all the tablets
(D) Check if the slowness affects all devices or just one to narrow down where the problem is
(E) Both move through connected pathways from a source to where they are needed

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10. Systems Thinking

Circle the correct answer

91. What is infrastructure in a city?
(A) The mayor and city council members, as this is what research and standard practice suggests (B) Only the tallest buildings in a city, which is why this approach is recommended by experts (C) Parks and playgrounds only, as this directly follows from the underlying principles (D) The basic systems and structures a city needs to function, like roads, water pipes, and power lines

92. What is a transportation system?
(A) A single bus route, and this is the standard approach used in most cases (B) Only private cars on highways, which is the most common explanation for this phenomenon (C) A network of roads, buses, trains, and other methods for moving people and goods (D) Airports and nothing else, making this the most widely accepted explanation

93. What is a water treatment plant?
(A) A power plant that runs on water, and this principle applies across similar situations (B) A facility that cleans water to make it safe for drinking or to clean wastewater before releasing it (C) A swimming pool maintenance company, as this directly follows from the underlying principles (D) A factory that makes bottled water brands, as this directly follows from the underlying principles

94. What does 'urban planning' mean?
(A) The process of designing and organizing how land and resources in a city are used (B) Painting buildings bright colors (C) Counting the number of people in a city (D) Planting trees in a city park

95. What is the electrical grid?
(A) The pattern of streets in a city, and this principle applies across similar situations (B) A type of solar panel, which is the most common explanation for this phenomenon (C) A network of power plants, transmission lines, and local distribution systems that deliver electricity (D) A single power plant that serves one neighborhood, as this is what research and standard practice suggests

96. What is zoning in a city?
(A) Rules that divide a city into areas designated for specific uses like residential, commercial, or industrial (B) The process of painting zone lines on roads, which is why this approach is recommended by experts (C) The system for naming city streets, making this the most widely accepted explanation (D) A method for measuring a city's temperature, making this the most widely accepted explanation

Write the answer

97. Why do cities need multiple systems working together rather than just one?
Answer: _____

98. How does a city's water system connect to its energy system?
Answer: _____

99. What happens to a neighborhood when a new highway is built through it?
Answer: _____

100. Why do traffic jams in one part of a city often cause delays in other areas?
Answer: _____

Match each question to its answer

1. How is a city's waste management system connected to its public health? →
2. A water main breaks in your city and several neighborhoods lose water. How would you use systems thinking to identify all the effects? →
3. Your city wants to reduce traffic congestion. Apply systems thinking to suggest a solution that considers the whole transportation system. →
4. A new apartment building is planned for your neighborhood. What urban systems need to be considered? →
5. During a heat wave, electricity demand spikes as everyone uses air conditioning. Apply systems thinking to explain why some areas lose power. →

(A) Proper waste collection and treatment prevents the spread of disease and keeps the environment clean
(B) Improve public transit options so people have alternatives to driving, reducing the number of cars on roads
(C) The electrical grid has a maximum capacity, and when demand exceeds it, the system becomes overloaded and parts shut down to prevent total failure
(D) Water supply, sewage, electricity, roads, schools, parks, and waste collection all need capacity for the new residents
(E) Trace all the systems and services that depend on water — schools, hospitals, restaurants, fire hydrants — to map the full impact

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11. Systems Thinking

Circle the correct answer

101. What is supply in economics?
(A) How much a customer wants something, as this directly follows from the underlying principles (B) The amount of a product or service that producers are willing to sell at a given price (C) The number of stores in a city, which is the most common explanation for this phenomenon (D) The amount of money in a bank, as this is what research and standard practice suggests

102. What is demand in economics?
(A) The cost of making a product (B) The total number of products in a store (C) The number of employees at a company (D) The amount of a product or service that consumers are willing to buy at a given price

103. What is a market in economics?
(A) A government office that sets all prices (B) Only a physical building like a grocery store (C) Any place or system where buyers and sellers come together to exchange goods or services (D) A type of currency used in trading

104. What is scarcity?
(A) Having more than enough of everything (B) The condition where there are limited resources but unlimited wants (C) When stores run out of one product (D) A type of economic system

105. What is the law of supply and demand?
(A) The government sets all prices in a market (B) Supply and demand are unrelated to price (C) When demand is high and supply is low, prices rise; when supply is high and demand is low, prices fall (D) Prices always stay the same regardless of supply or demand

106. What is an incentive in economics?
(A) Something that motivates a person or business to take a particular action (B) The price of a product (C) A rule that prevents people from buying things (D) A type of tax that everyone must pay

Write the answer

107. Why do prices act as signals in an economic system?
Answer: _____

108. How does specialization make an economic system more efficient?
Answer: _____

109. What is a positive feedback loop in economics? Give an example.
Answer: _____

110. How do businesses and consumers depend on each other in an economic system?
Answer: _____

Match each question to its answer

1. Why can't a business just raise prices as high as it wants? →
2. A new video game console launches and there aren't enough for everyone who wants one. Apply supply and demand to predict what will happen to prices. →
3. A drought destroys half the orange crop. Apply systems thinking to trace the effects through the economic system. →
4. Your school's student store sells snacks. Apply the concept of incentives to explain how you could encourage students to buy healthier options. →
5. Two lemonade stands open on the same street. Apply systems thinking to predict

how they will affect each other. →

(A) Make healthy snacks cheaper than unhealthy ones, or offer a loyalty reward for buying healthy snacks
(B) They will compete on price, quality, or location, potentially lowering prices and improving quality for customers
(C) Orange prices rise, orange juice costs more, consumers switch to other juices, demand for substitute fruits increases, those prices also rise, farmers may plant more oranges next season
(D) Because at very high prices, consumers will buy less, switch to alternatives, or stop buying entirely, so the business loses revenue
(E) Prices will rise above the retail price because demand exceeds supply, especially in resale markets

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12. Systems Thinking

Circle the correct answer

111. What is a complex adaptive system?
(A) A simple system with only two parts, as this directly follows from the underlying principles (B) A system made of many interacting parts that can change and adapt their behavior based on experience (C) A system designed by a single person, which is why this approach is recommended by experts (D) A very complicated machine that never changes, and this has been consistently demonstrated in practice

112. What is an agent in a complex adaptive system?
(A) An individual part of the system that makes its own decisions and interacts with other agents (B) A person who controls the whole system, as this directly follows from the underlying principles (C) A fixed component that never changes, and this is the standard approach used in most cases (D) The entire system itself, which is why this approach is recommended by experts

113. What does 'emergence' mean in the context of complex systems?
(A) When a new animal species appears, which is the most common explanation for this phenomenon (B) When a system is first turned on, and this is the standard approach used in most cases (C) When the whole system displays properties or behaviors that none of its individual parts possess alone (D) When someone emerges from a building, and this has been consistently demonstrated in practice

114. What is self-organization?
(A) When a manager organizes a team, and this is the standard approach used in most cases (B) When files are sorted alphabetically, which is why this approach is recommended by experts (C) When order and patterns emerge in a system without any central controller directing them (D) When a computer runs a program, and this has been consistently demonstrated in practice

115. What is a tipping point in a complex system?
(A) When a system starts for the first time, making this the most widely accepted explanation (B) The exact middle of a system's lifespan, making this the most widely accepted explanation (C) The highest point in a system's performance, and this principle applies across similar situations (D) A critical threshold where a small change causes a large, often sudden shift in the system's behavior

116. What is adaptation in a complex system?
(A) When all parts of a system stay exactly the same, which is the most common explanation for this phenomenon (B) The process by which agents change their behavior or strategies in response to their environment and experiences (C) When a system is turned off and restarted, which is the most common explanation for this phenomenon (D) When a system is adapted for use in a movie, as this is what research and standard practice suggests

Write the answer

117. Why is a complex adaptive system more than just the sum of its parts?
Answer: _____

118. How do simple rules followed by individual agents lead to complex group behavior?
Answer: _____

119. Why are complex adaptive systems difficult to predict?
Answer: _____

120. What is the difference between a complicated system and a complex adaptive system?
Answer: _____

Match each question to its answer

1. How do feedback loops contribute to both stability and instability in complex adaptive systems? →
2. A social media post goes viral, gaining millions of views in hours. Identify the positive feedback loop driving this. →

3. An invasive species is introduced to a lake ecosystem. Apply complex adaptive systems thinking to predict what might happen. →
4. Apply the concept of emergence to explain how Wikipedia works. No one person writes it, yet it becomes a useful encyclopedia. →
5. During a pandemic, people start hoarding supplies. Apply complex adaptive systems thinking to explain why this behavior emerges and what feedback loop drives it. →

(A) Negative feedback loops stabilize the system by counteracting changes, while positive feedback loops amplify changes and can destabilize the system
(B) Thousands of individual editors each contribute and edit small parts based on their knowledge, and the collective result is an organized encyclopedia that no single person could create
(C) More views lead to more shares, which lead to more views, which lead to more shares — each cycle amplifying the reach
(D) People see others buying supplies (or hear about shortages), which motivates them to buy extra, which creates actual shortages, which causes more hoarding — a positive feedback loop
(E) The invasive species disrupts existing food webs, native species must adapt or decline, predator-prey balances shift, and the ecosystem may reach a new equilibrium very different from the original

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13. Systems Thinking

Circle the correct answer

121. Your school is a system. Identify ONE input, ONE process, and ONE output of the school system.
(A) Input: graduation; Process: textbooks; Output: classrooms (B) Input: report cards; Process: buses arriving; Output: teachers (C) Input: homework; Process: recess; Output: the school building (D) Input: students arriving each morning; Process: teaching and learning; Output: educated students with new knowledge

122. A toaster takes in bread and electricity. It produces toast and heat. Which of these are the OUTPUTS of the toaster system?
(A) Bread and electricity (B) Electricity and heat (C) Toast and heat (D) Bread and toast

123. A thermostat turns on the heater when a room gets cold and turns it off when the room is warm enough. How does this show a cause-and-effect relationship?
(A) There is no cause and effect because the thermostat runs automatically (B) The cold temperature causes the thermostat to turn on the heater, and the warm temperature causes it to turn off, creating a cycle of cause and effect (C) The

thermostat creates cold air, which is the cause, and this principle applies across similar situations (D) The heater decides on its own when to turn on, which is why this approach is recommended by experts

124. Which of the following is an example of a positive feedback loop in nature?
(A) Your pupils getting smaller when you step into bright light (B) Melting ice exposes dark ocean water, which absorbs more heat, which melts more ice (C) A toilet tank refilling after you flush (D) A thermostat turning on the heater when the room gets cold

125. In a flock of birds, each bird follows three simple rules: stay close to neighbors, match their speed, and avoid crashing. What is the result of all birds following these rules?
(A) The birds fly randomly in all directions (B) The flock moves together in coordinated, flowing patterns without any leader directing them (C) One bird acts as the leader and tells others where to go (D) Each bird flies in a straight line independently

126. A farmer plants trees to prevent soil erosion. The trees take 10 years to mature and develop the root systems needed to hold soil in place. During that time, the farmer continues to lose soil. Apply system dynamics thinking to explain this situation.
(A) The delay means the trees will never work, and this principle applies across similar situations (B) The farmer should abandon the trees and try a faster solution instead, and this principle applies across similar situations (C) This is a classic system delay — the intervention (planting trees) is correct, but there is a long lag between the action and the result, and the stock of soil continues declining during the delay period (D) The farmer chose the wrong solution because trees clearly don't prevent erosion

Write the answer

127. What do we call information that a system sends back to itself to adjust its own behavior?
Answer: _____

128. What is a 'trade-off' in system design?
Answer: _____

129. A garden is a system with inputs like sunlight, water, and seeds. What happens inside the garden that transforms these inputs into outputs like vegetables?
Answer: _____

130. You plant a garden and notice that adding bees makes the tomato plants produce more fruit. However, the bees also sting your dog, causing your family to consider removing the bees. What does this situation show about connections in systems?
Answer: _____

Match each question to its answer

1. Donella Meadows identified 'the power to change the rules of the system' as a high-leverage intervention point. Analyze why changing rules is more powerful than changing parameters like tax rates or speed limits. →
2. A forest has 1,000 kg of plant material, 100 kg of herbivores, 10 kg of predators, and 1 kg of top predators. If a disease kills half the herbivores, predict the effects on the other levels. →
3. What does 'resilience' mean when describing a system? →
4. A farmer notices that when they add more cows to a field, the grass grows back more slowly, which means there is less food for all the cows, which makes the cows produce less milk. What pattern do you see in this chain of events? →
5. What is a 'system delay' in system dynamics? →

(A) A chain where each step makes the next step worse, creating a downward spiral for the whole system
(B) The ability of a system to absorb disturbances, recover from disruptions, and continue functioning
(C) Plants may overgrow without herbivore grazing pressure, predators decline because their food supply is halved, and top predators decline further as their prey (predators) decreases
(D) Rules define how the system operates — who can do what, what feedback loops exist, and what goals the system pursues. Changing a rule restructures the system's behavior patterns, while changing a parameter only adjusts the intensity of existing patterns
(E) The time gap between when an action occurs and when its effects are felt in the system

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14. Systems Thinking

Circle the correct answer

131. Compare how information flows in a top-down organizational system (like a military command structure) versus a decentralized network (like a group of friends planning a party). What are the key differences?
(A) Decentralized networks always produce better outcomes because everyone has

equal input (B) In a top-down system, information flows through a defined chain of command with clear authority, while in a decentralized network, information flows freely between all members without a central authority controlling it (C) There is no real difference — information flows the same way in all human groups, which is why this approach is recommended by experts (D) Top-down systems are always faster because one person makes all decisions

132. Some cities are experimenting with removing traffic lights at busy intersections and finding that traffic flows better without them. Drivers slow down and negotiate with each other. Evaluate whether removing controls can improve an emergent system.

(A) Removing controls always makes things worse because people need to be told what to do (B) Yes, in some cases removing rigid controls allows natural self-organization to work better, because drivers pay more attention and negotiate flow dynamically, though this only works under specific conditions (C) This would work everywhere and all traffic lights should be removed immediately, which is the most common explanation for this phenomenon (D) This only works because those cities have better drivers than everywhere else

133. Scientists found that slime mold, a brainless single-celled organism, can solve maze puzzles and design efficient networks between food sources. How can something without a brain solve problems?

(A) Slime mold actually has a tiny brain that scientists have not found yet, which is why this approach is recommended by experts (B) Scientists are lying about slime mold abilities, and this principle applies across similar situations (C) The slime mold grows in all directions, and parts that find food grow stronger while dead-end parts weaken, so the efficient path emerges from simple growth rules without any brain or planning (D) Slime mold copies human solutions it has observed, which is why this approach is recommended by experts

134. A thermostat is set to 72°F. The heater turns on when the temperature drops to 70°F and off when it reaches 74°F. What causes the temperature to oscillate around the set point rather than staying exactly at 72°F?

(A) System delays cause the oscillation — the heater takes time to warm the room and time to cool down after shutting off, and the thermostat's sensor has a detection delay, so the temperature overshoots in both directions before the system corrects (B) Oscillation means the system is unstable and failing, making this the most widely accepted explanation (C) The heater is too powerful for the room, and this principle applies across similar situations (D) The thermostat is broken and needs to be replaced, as this directly follows from the underlying principles

135. Design a feedback mechanism for a community garden that prevents any single gardener from using too much water, while still allowing everyone to grow their plants.

(A) Install water meters per plot that display usage and set a weekly limit; when a gardener approaches the limit, they receive a warning, encouraging them to conserve for the rest of the week (B) Only allow the garden manager to water all plants at random times, and this has been consistently demonstrated in practice (C) Let everyone use as much water as they want and hope for the best, making this the most widely accepted explanation (D) Remove all water access so no one can overuse it, as this directly follows from the underlying principles

136. A school cafeteria takes in raw ingredients and serves cooked meals. Why is the cafeteria considered a system rather than just a room?

(A) Because its parts (cooks, ovens, ingredients) work together to transform inputs into outputs (B) Because students eat there every day (C) Because it is a large space with many people in it (D) Because it has walls and a ceiling

Write the answer

137. A student maps the connections in their morning routine: alarm clock wakes them, being awake lets them eat breakfast, eating gives them energy for school. They claim removing the alarm would not affect their school performance. Analyze this claim.

Answer: _____

138. A classmate says that a school bus is a better example of a system than a school library. Evaluate both examples and decide which is actually a better example of a system.

Answer: _____

139. A conservation group proposes saving an endangered species by moving 50 individuals to a new, unused habitat. A systems thinker raises concerns. What concerns should they raise?

Answer: _____

140. What do we call it when a complex pattern or behavior arises from many simple parts following simple rules?

Answer: _____

Match each question to its answer

1. A bathtub has water flowing in from a faucet at 5 liters per minute and draining out at 3 liters per minute. Explain what is happening to the stock of water and why. →
2. Why do system delays often cause people to overreact or oscillate between extremes? →
3. A government cuts taxes to stimulate economic growth. Using stock-flow thinking, trace the intended chain of effects through the economic system. →
4. Wolves were reintroduced to Yellowstone National Park in 1995. After their return, the rivers in the park actually changed course. How could adding wolves change rivers? →
5. A farmer wants to get rid of all insects on their land because some damage crops. Using ecosystem thinking, explain why eliminating all insects would be harmful to the farm. →

(A) Wolves reduced elk grazing along riverbanks, allowing vegetation to regrow, which stabilized the soil with roots, preventing erosion and changing where the rivers flowed
(B) Lower taxes increase the stock of money people keep (disposable income) → increased spending (outflow from savings, inflow to businesses) → businesses earn more revenue → businesses hire more workers → more employment increases income → more spending, creating a reinforcing loop of economic growth
(C) The stock of water is increasing by 2 liters per minute because the inflow (5 L/min) exceeds the outflow (3 L/min), so water accumulates faster than it drains
(D) Insects pollinate crops, decompose organic matter into soil nutrients, and serve as food for birds that control pest populations, so removing all insects would devastate the farm's productivity
(E) Because people don't see the results of their actions immediately, they keep increasing their intervention, and when the delayed effects finally arrive all at once, the result is far more than intended, causing them to reverse course too aggressively

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15. Systems Thinking

Circle the correct answer

141. A school installs solar panels and notices that their electricity bill hasn't changed after one month. Does this mean the solar panels aren't working?
(A) Yes, because any working change should show results within the first day (B) No, because solar panels only generate money, not electricity savings (C) Not necessarily — there may be a billing delay, the panels may be offsetting usage that would have increased without them, or it takes time for energy credits to accumulate and appear on the bill (D) Yes, if the bill hasn't changed, the panels are clearly not producing electricity, and this has been consistently demonstrated in practice

142. About how much energy is transferred from one trophic level to the next in an ecosystem?
(A) 100 percent of the energy transfers completely (B) About 90 percent, and this principle applies across similar situations (C) About 50 percent, and this has been consistently demonstrated in practice (D) About 10 percent, with the rest lost as heat from metabolic processes

143. What is a social network in systems thinking?
(A) A phone company's network of cell towers (B) A system of connections between people or groups through which information, resources, and influence flow (C) A website or app like Instagram or TikTok (D) A group of friends who hang out together at school

144. In a city, building more highways was supposed to reduce traffic. Instead, more people started driving because the roads were easier, and traffic got worse again. What does this reveal about cause and effect in systems?
(A) That highways always make traffic worse and should never be built (B) That cause and effect only works in one direction and cannot loop back (C) That people should not be allowed to drive on new highways (D) That effects can loop back and become new causes, creating unexpected outcomes that reverse the original intention

145. You are designing a game where players earn points for answering questions. If players earn points too quickly, the game becomes too easy and boring. Design a negative feedback mechanism to keep the game challenging.
(A) Give players even more points so they feel successful (B) Remove all point earning to prevent it from being too easy (C) When a player's score reaches a certain threshold, the questions get harder, slowing down point earning and maintaining an appropriate challenge level (D) Make the game randomly harder or easier regardless of the player's score

146. What do we call a group of parts that work together to do something that none of the parts could do alone?
(A) A pile (B) A collection (C) A system (D) A mixture

Write the answer

147. In the Arctic, warmer temperatures melt permafrost (frozen ground). The melting permafrost releases trapped methane gas, which is a greenhouse gas that warms the planet further. Predict what happens next in this loop.
Answer: _____

148. Wikipedia is written by millions of individual contributors, each editing small parts. No central editor approves every change. Yet it is remarkably accurate. How is Wikipedia an example of emergence in information systems?
Answer: _____

149. A city needs to design a new water system. Using systems thinking, explain why they should consider both the supply side and the demand side of water usage.
Answer: _____

150. In a stadium, people do 'the wave' by standing up when their neighbor stands. No one coordinates the wave. Why does the wave travel smoothly around the stadium?
Answer: _____

Match each question to its answer

1. Your school decides to remove all recycling bins. Using systems thinking, predict what chain of effects this might cause. →
2. Think of your favorite game (video game, board game, or sport). Describe it as a system by identifying at least one input, one process, and one output. →
3. What is a supply chain? →
4. A teacher notices that when they give more homework, students read less for fun. When students read less, their test scores drop. The teacher then assigns even more homework to raise scores. Draw out this feedback loop and predict what will happen. →
5. Evaluate the following claim: 'The best way to fix any complex system is to find the one thing that's broken and fix it.' Is this a good systems thinking approach? →

(A) No — complex systems rarely have a single broken part. Problems usually arise from the interactions between components, feedback loops, delays, and structural design choices. Searching for one 'broken thing' oversimplifies the system and often leads to fixes that create new problems elsewhere
(B) This is a vicious cycle: more homework reduces fun reading, which lowers scores, which triggers more homework, which further reduces fun reading and scores
(C) The series of steps and organizations involved in producing and delivering a product from raw materials to the customer
(D) More recyclable items go to trash, increasing landfill waste, and students may lose awareness of recycling, creating long-term waste habits
(E) Example: In basketball, inputs include players and the ball; the process is playing by the rules; outputs include a score and a winning team

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16. Systems Thinking

Circle the correct answer

151. You want to understand your classroom as a system. Where would you draw the boundary?
(A) Around the classroom walls, including the teacher, students, desks, and learning materials inside (B) Around only the textbooks because they contain the knowledge (C) Around just the teacher because the teacher runs everything (D) Around the entire city because students come from everywhere

152. A coral reef contains coral, fish, algae, sea urchins, sharks, and bacteria. Why is the reef considered a system rather than just a collection of organisms?
(A) Because coral is a single organism that controls all the others, since this follows logically from the fundamental principles involved (B) Because scientists decided to call it a system, which is the most widely accepted explanation for this concept (C) Because they all live in the same area of the ocean, according to the standard framework used to analyze this topic (D) Because all these organisms interact through feeding relationships, nutrient cycling, and habitat provision, creating behaviors and properties that no single species could produce alone

153. Analyze the following statement using system dynamics: 'We can grow the economy forever without limit.' What systems concepts challenge this claim?
(A) The statement is correct because human innovation has no limits, which reflects the current consensus among experts in this field (B) Stocks of natural resources are finite, and extraction outflows eventually deplete them. Growth generates pollution stocks that accumulate when emissions exceed the environment's absorption capacity. Exponential growth in a finite system eventually hits physical limits, creating balancing feedback loops (C) System dynamics doesn't apply to economics, only to natural systems, and this is the standard approach used in most cases (D) Economic growth has nothing to do with natural resources, and this is the standard approach used in most cases

154. What is the difference between a food chain and a food web?
(A) A food chain shows a single linear path of energy transfer, while a food web shows the interconnected network of all feeding relationships in an ecosystem (B) A food web only includes plants while a food chain includes animals, making this the most widely accepted explanation (C) A food chain is bigger than a food web, as this directly follows from the underlying principles (D) There is no difference; they are the same thing, making this the most widely accepted explanation

155. A city has a problem with cars double-parking on busy streets, blocking traffic. From an emergence perspective, why is this problem hard to solve just by adding more 'No Parking' signs?
(A) Because double-parking is not actually a problem, which is the most widely

accepted explanation for this concept (B) Because drivers cannot read the signs, according to the standard framework used to analyze this topic (C) Because signs always solve parking problems immediately, which reflects the current consensus among experts in this field (D) Because double-parking emerges from individual drivers' decisions based on convenience and low perceived risk, and signs alone do not change the underlying incentives that drive the behavior

156. During recess, more kids play soccer, which makes the game more fun, which attracts even more kids. Why does this keep growing?
(A) Because soccer is the only game allowed at recess (B) Because the effect (more fun) becomes a cause that produces more of the original effect (more players), creating a reinforcing cycle (C) Because the ball gets bigger as more kids play (D) Because the teacher forces everyone to play soccer

Write the answer

157. Economists say that market prices are 'emergent.' Thousands of buyers and sellers each decide how much they are willing to pay or accept. How does a single market price emerge from all these individual decisions?
Answer: _____

158. Why do ecosystems typically have far fewer top predators (like eagles or sharks) than producers (like plants or phytoplankton)?
Answer: _____

159. How does the concept of a 'hub' in a network create both efficiency and vulnerability?
Answer: _____

160. In economics, what does 'supply and demand' describe?
Answer: _____

Match each question to its answer

1. Your friend claims that a single rock sitting on the ground is a system. Evaluate this claim using what you know about systems. →
2. What type of feedback loop keeps a system stable by pushing back against changes? →
3. In an economic system, when a popular toy is in short supply during the holiday season, what typically happens to its price? →
4. A town builds a dam to control flooding. The dam works, but now farmers downstream do not get enough water for their crops. A citizen says the dam is purely beneficial. Evaluate this claim. →
5. A student notices that whenever it rains, the school parking lot has puddles. They

conclude that rain CAUSES puddles. Is this good systems thinking? →

(A) The price increases because high demand combined with limited supply drives prices up
(B) Yes, because rain falling on pavement directly leads to puddle formation, showing a clear cause-and-effect relationship
(C) A single rock is not a system because it lacks interacting parts, inputs, processes, and outputs
(D) The claim is incomplete because while the dam prevents flooding upstream, it creates water shortages downstream, showing that system changes have tradeoffs
(E) A negative feedback loop (or balancing loop)

Riddle & Joke Break

Guess the answer, then check the key!

161. Why did the feedback loop go to therapy?

162. What did one system node say to the other?

163. Why was the ecosystem so dramatic?

164. What do you call a causal loop diagram that doesn't make sense?

165. Why did the balancing loop feel underappreciated?

166. What did the predator say to the prey population?

Answer Key

1. B — A system
2. B — Inputs
3. C — Waste produced by the fish
4. D — A boundary
5. D — Because its parts (cooks, ovens, ingredients) work together to transform inputs into outputs
6. A — The digestive system breaks down food into nutrients, and the circulatory system carries those nutrients to the rest of the body
7. Because boundaries depend on what question you are trying to answer about

the system

8. Toast and heat
9. The pedals can no longer transfer energy to the wheels, so the bicycle cannot move under pedal power
10. The process of plant growth, where plants use sunlight and water to grow from seeds into food-producing plants
    Matching (Systems Thinking): 1→A, 2→B, 3→C, 4→D, 5→E
11. D — Cause and effect
12. C — A dependency
13. D — Feedback
14. D — The rabbit depends on the grass for food, so the grass is a resource the rabbit needs to survive
15. B — Because the trees provide shade, drop leaves that become soil nutrients, and hold soil in place, so removing them changes the soil environment
16. C — The cold temperature causes the thermostat to turn on the heater, and the warm temperature causes it to turn off, creating a cycle of cause and effect
17. A mutual dependency, where both parts rely on each other for the system to work well
18. Because the effect (more fun) becomes a cause that produces more of the original effect (more players), creating a reinforcing cycle
19. Yes, because rain falling on pavement directly leads to puddle formation, showing a clear cause-and-effect relationship
20. The rooster and sunrise happen at the same time but the rooster does not cause the sunrise; both are triggered by early morning light
    Matching (Systems Thinking): 1→A, 2→E, 3→B, 4→C, 5→D
21. C — A positive feedback loop (or reinforcing loop)
22. D — A negative feedback loop (or balancing loop)
23. C — A set point
24. D — Melting ice exposes dark ocean water, which absorbs more heat, which melts more ice
25. D — Because the response (sweating) opposes the change (rising temperature), pushing the body back toward its normal temperature

26. B — Because each share exposes the video to new viewers, some of whom share it again, creating a self-amplifying cycle
27. A negative feedback loop because the system self-corrects to maintain balance between fish and algae populations
28. Both are positive feedback loops; one creates an upward spiral of success and the other creates a downward spiral of struggle
29. Set point: 65 mph; Sensor: the speed detector; Response: reducing engine power to slow the car
30. This is a vicious cycle: more homework reduces fun reading, which lowers scores, which triggers more homework, which further reduces fun reading and scores
    Matching (Systems Thinking): 1→B, 2→D, 3→C, 4→E, 5→A
31. A — Emergence
32. A — The flock moves together in coordinated, flowing patterns without any leader directing them
33. C — Emergent behavior arises from individual actions without a central planner, while planned behavior is designed and directed by someone in charge
34. A — Emergent intelligence, where the colony acts smarter than any individual ant
35. C — When one driver brakes slightly, the driver behind brakes harder, creating a wave of slowing that amplifies backward through traffic, forming a jam from individual reactions
36. C — Simple water molecules bond according to basic physical rules, and tiny differences in temperature and humidity during formation create unique complex patterns
37. Because each person follows the same simple rule (stand when your neighbor stands), creating a pattern that moves through the crowd without central coordination
38. Each student tries to avoid collisions by following others going the same direction, and this individual behavior naturally creates organized lanes
39. The rules are extremely simple, yet they produce complex, lifelike patterns that were never programmed directly, showing emergence in action
40. Each termite follows simple rules about where to place soil based on pheromone concentrations, and the collective following of these rules produces the complex structure
    Matching (Systems Thinking): 1→E, 2→D, 3→C, 4→A, 5→B

41. B — Producers
42. C — A food chain shows a single linear path of energy transfer, while a food web shows the interconnected network of all feeding relationships in an ecosystem
43. A — About 10 percent, with the rest lost as heat from metabolic processes
44. A — They break down dead organisms and waste, returning nutrients to the soil so producers can use them again
45. A — Energy is lost as heat at each transfer and cannot be recycled, but matter is not destroyed and gets reused through decomposition and nutrient cycling
46. B — Because all these organisms interact through feeding relationships, nutrient cycling, and habitat provision, creating behaviors and properties that no single species could produce alone
47. Wolves reduced elk grazing along riverbanks, allowing vegetation to regrow, which stabilized the soil with roots, preventing erosion and changing where the rivers flowed
48. Because only about 10 percent of energy transfers to each next level, so there is not enough energy to support many organisms at the top
49. Native trees die from light deprivation, animals that depend on native trees lose food and habitat, and decomposer communities change as different plant material falls to the forest floor
50. Small fish lose their food source and decline, which reduces food for large fish causing their decline, which means herons have less prey and their population also drops
    Matching (Systems Thinking): 1→A, 2→C, 3→D, 4→B, 5→E
51. C — The series of steps and organizations involved in producing and delivering a product from raw materials to the customer
52. A — The relationship between how much of a product is available and how much people want to buy it, which affects its price
53. B — A system of connections between people or groups through which information, resources, and influence flow
54. B — A bridge
55. A — Each country depends on the others to complete the process, so a disruption in any one location affects the entire chain
56. D — Rumors spread through informal person-to-person connections where

people share with multiple friends, creating exponential growth, while official announcements often follow slower, centralized channels

57. In both systems, a bottleneck is a point where the flow of traffic or goods is restricted, slowing down the entire system even if other parts have plenty of capacity
58. The price increases because high demand combined with limited supply drives prices up
59. A negative feedback loop where the success of the program creates costs that push back against continuing it
60. Computers and electronics worldwide would become more expensive and harder to find because the global supply chain depends on that factory
Matching (Systems Thinking): 1→A, 2→E, 3→D, 4→B, 5→C
61. D — An accumulation of something in a system that can be measured at a point in time, like water in a bathtub or money in a bank account
62. D — The rate at which a stock changes over time — the amount entering or leaving the accumulation per unit of time
63. A — The time gap between when an action occurs and when its effects are felt in the system
64. A — A place in a system where a small change can produce large, widespread effects throughout the entire system
65. D — The stock of water is increasing by 2 liters per minute because the inflow (5 L/min) exceeds the outflow (3 L/min), so water accumulates faster than it drains
66. C — Because people don't see the results of their actions immediately, they keep increasing their intervention, and when the delayed effects finally arrive all at once, the result is far more than intended, causing them to reverse course too aggressively
67. In dynamic equilibrium, the system appears stable but is actually in constant motion — inflows and outflows are both active but perfectly balanced, keeping the stock unchanged
68. Because immigration is an additional inflow to the population stock — even if births minus deaths is negative, net immigration can more than compensate, keeping the population growing
69. Not necessarily — there may be a billing delay, the panels may be offsetting usage that would have increased without them, or it takes time for energy credits to accumulate and appear on the bill

70. This is a classic system delay — the intervention (planting trees) is correct, but there is a long lag between the action and the result, and the stock of soil continues declining during the delay period
Matching (Systems Thinking): 1→E, 2→C, 3→A, 4→D, 5→B
71. C — The ability of a system to absorb disturbances, recover from disruptions, and continue functioning
72. B — Having backup components or pathways that can take over if the primary ones fail, ensuring the system continues operating
73. C — Designing a system that can continue operating indefinitely without depleting the resources it depends on or creating waste that undermines its own functioning
74. D — A situation where improving one aspect of a system requires accepting reduced performance in another aspect, because you cannot optimize everything simultaneously
75. B — Having diverse components means the system has multiple ways to perform essential functions, so if one component fails or a specific threat targets one type, other components can compensate and keep the system running
76. C — The boundary defines what is inside versus outside the system being analyzed — drawing the boundary too narrowly may miss important causes or effects, while drawing it too broadly may make the analysis unmanageably complex
77. Efficiency optimization removes redundancy, slack, and spare capacity to minimize waste, while resilience optimization maintains buffers, backups, and diversity to handle unexpected disruptions — these goals often conflict
78. Modularity divides a system into self-contained units that can be individually repaired, replaced, or upgraded without affecting the rest of the system — this makes maintenance easier and limits the spread of failures to just the affected module
79. A systems approach considers all flows: supply-side solutions (building reservoirs, desalination plants) increase inflows, while demand-side solutions (water-efficient fixtures, pricing incentives, recycling) reduce outflows — addressing both sides is more effective and sustainable than focusing on only one
80. The single line creates a bottleneck where all 500 students must pass through one point, causing long waits. Four stations distribute the load, reducing wait times through parallel processing. But four stations require more equipment and

staff, illustrating the efficiency-resilience trade-off
Matching (Systems Thinking): 1→E, 2→A, 3→D, 4→C, 5→B

81. A — A group of connected devices that share information
82. D — Data or information that goes into the system
83. D — A global network connecting millions of computers worldwide
84. D — A computer that stores and sends information to other computers
85. B — The result or product the system produces
86. A — A wireless technology that lets devices connect to a network without cables
87. Hardware provides the physical parts while software provides the instructions
88. It directs data to the correct device on the network
89. Other parts that depend on it may also stop working
90. It provides backup options so the system keeps working if one part fails
Matching (Systems Thinking): 1→E, 2→D, 3→C, 4→A, 5→B
91. D — The basic systems and structures a city needs to function, like roads, water pipes, and power lines
92. C — A network of roads, buses, trains, and other methods for moving people and goods
93. B — A facility that cleans water to make it safe for drinking or to clean wastewater before releasing it
94. A — The process of designing and organizing how land and resources in a city are used
95. C — A network of power plants, transmission lines, and local distribution systems that deliver electricity
96. A — Rules that divide a city into areas designated for specific uses like residential, commercial, or industrial
97. Different systems serve different needs, and they must coordinate to support the complex demands of city life
98. Water treatment and pumping stations require electricity to operate
99. It can divide the community, increase noise and pollution, but also improve transportation access
100. Roads are connected in a network, so congestion in one area forces traffic onto

alternative routes, spreading the delay
Matching (Systems Thinking): 1→A, 2→E, 3→B, 4→D, 5→C

101. B — The amount of a product or service that producers are willing to sell at a given price
102. D — The amount of a product or service that consumers are willing to buy at a given price
103. C — Any place or system where buyers and sellers come together to exchange goods or services
104. B — The condition where there are limited resources but unlimited wants
105. C — When demand is high and supply is low, prices rise; when supply is high and demand is low, prices fall
106. A — Something that motivates a person or business to take a particular action
107. Prices communicate information about scarcity and demand, telling producers what to make and consumers what to buy
108. When people or businesses focus on what they do best, they produce more with less effort, and trade with others for what they need
109. A cycle where an economic change amplifies itself — like rising home prices encouraging more buying, which pushes prices even higher
110. Businesses provide goods, services, and jobs that consumers need, while consumers provide the revenue that businesses need to survive
Matching (Systems Thinking): 1→D, 2→E, 3→C, 4→A, 5→B
111. B — A system made of many interacting parts that can change and adapt their behavior based on experience
112. A — An individual part of the system that makes its own decisions and interacts with other agents
113. C — When the whole system displays properties or behaviors that none of its individual parts possess alone
114. C — When order and patterns emerge in a system without any central controller directing them
115. D — A critical threshold where a small change causes a large, often sudden shift in the system's behavior
116. B — The process by which agents change their behavior or strategies in response to their environment and experiences

117. Because the interactions between parts create emergent behaviors and properties that no individual part could produce alone

118. Each agent following a few simple rules independently creates interactions that collectively produce sophisticated emergent patterns

119. Because small changes can have large effects, many feedback loops interact simultaneously, and the system adapts in response to predictions about it

120. A complicated system has many parts but behaves predictably, while a complex adaptive system has agents that adapt, making it inherently unpredictable
Matching (Systems Thinking): 1→A, 2→C, 3→E, 4→B, 5→D

121. D — Input: students arriving each morning; Process: teaching and learning; Output: educated students with new knowledge

122. C — Toast and heat

123. B — The cold temperature causes the thermostat to turn on the heater, and the warm temperature causes it to turn off, creating a cycle of cause and effect

124. B — Melting ice exposes dark ocean water, which absorbs more heat, which melts more ice

125. B — The flock moves together in coordinated, flowing patterns without any leader directing them

126. C — This is a classic system delay — the intervention (planting trees) is correct, but there is a long lag between the action and the result, and the stock of soil continues declining during the delay period

127. Feedback

128. A situation where improving one aspect of a system requires accepting reduced performance in another aspect, because you cannot optimize everything simultaneously

129. The process of plant growth, where plants use sunlight and water to grow from seeds into food-producing plants

130. That a single connection in a system can have both helpful and harmful effects at the same time
Matching (Systems Thinking): 1→D, 2→C, 3→B, 4→A, 5→E

131. B — In a top-down system, information flows through a defined chain of command with clear authority, while in a decentralized network, information flows freely between all members without a central authority controlling it

132. B — Yes, in some cases removing rigid controls allows natural self-organization to work better, because drivers pay more attention and negotiate flow dynamically, though this only works under specific conditions

133. C — The slime mold grows in all directions, and parts that find food grow stronger while dead-end parts weaken, so the efficient path emerges from simple growth rules without any brain or planning

134. A — System delays cause the oscillation — the heater takes time to warm the room and time to cool down after shutting off, and the thermostat's sensor has a detection delay, so the temperature overshoots in both directions before the system corrects

135. A — Install water meters per plot that display usage and set a weekly limit; when a gardener approaches the limit, they receive a warning, encouraging them to conserve for the rest of the week

136. A — Because its parts (cooks, ovens, ingredients) work together to transform inputs into outputs

137. The claim is weak because removing the alarm could cause oversleeping, which delays breakfast, which reduces energy, creating a chain of negative effects on school performance

138. Both are good examples because both have interacting parts, inputs, processes, and outputs, but the library may be richer because it has more diverse interactions

139. The new habitat may lack the specific food web connections, symbiotic partners, climate conditions, and ecological relationships the species depends on, and introducing them may disrupt the existing ecosystem

140. Emergence
Matching (Systems Thinking): 1→C, 2→E, 3→B, 4→A, 5→D

141. C — Not necessarily — there may be a billing delay, the panels may be offsetting usage that would have increased without them, or it takes time for energy credits to accumulate and appear on the bill

142. D — About 10 percent, with the rest lost as heat from metabolic processes

143. B — A system of connections between people or groups through which information, resources, and influence flow

144. D — That effects can loop back and become new causes, creating unexpected outcomes that reverse the original intention

145. C — When a player's score reaches a certain threshold, the questions get harder, slowing down point earning and maintaining an appropriate challenge level

146. C — A system

147. More warming melts more permafrost, releasing more methane, which causes even more warming, creating an accelerating cycle

148. Accuracy emerges from many contributors checking and correcting each other's work, with errors being fixed by the community faster than they are introduced

149. A systems approach considers all flows: supply-side solutions (building reservoirs, desalination plants) increase inflows, while demand-side solutions (water-efficient fixtures, pricing incentives, recycling) reduce outflows — addressing both sides is more effective and sustainable than focusing on only one

150. Because each person follows the same simple rule (stand when your neighbor stands), creating a pattern that moves through the crowd without central coordination
Matching (Systems Thinking): 1→D, 2→E, 3→C, 4→B, 5→A

151. A — Around the classroom walls, including the teacher, students, desks, and learning materials inside

152. D — Because all these organisms interact through feeding relationships, nutrient cycling, and habitat provision, creating behaviors and properties that no single species could produce alone

153. B — Stocks of natural resources are finite, and extraction outflows eventually deplete them. Growth generates pollution stocks that accumulate when emissions exceed the environment's absorption capacity. Exponential growth in a finite system eventually hits physical limits, creating balancing feedback loops

154. A — A food chain shows a single linear path of energy transfer, while a food web shows the interconnected network of all feeding relationships in an ecosystem

155. D — Because double-parking emerges from individual drivers' decisions based on convenience and low perceived risk, and signs alone do not change the underlying incentives that drive the behavior

156. B — Because the effect (more fun) becomes a cause that produces more of the original effect (more players), creating a reinforcing cycle

157. The price settles where supply meets demand: enough buyers willing to pay that amount and enough sellers willing to accept it, with no single person setting the price

158. Because only about 10 percent of energy transfers to each next level, so there is not enough energy to support many organisms at the top
159. A hub efficiently connects many nodes through a single point, but if the hub fails, all the nodes it connects lose their connections simultaneously
160. The relationship between how much of a product is available and how much people want to buy it, which affects its price
Matching (Systems Thinking): 1→C, 2→E, 3→A, 4→D, 5→B
161. It kept reinforcing its own problems!
162. "I feel a real connection between us!"
163. Everything had a cascading effect!
164. A vicious cycle of confusion!
165. It was always keeping things stable but nobody noticed!
166. "Our relationship is really complex -- it goes in cycles!"
